REMARKS

In the Office Action, the Examiner again rejected claims 1, 3, 5, 11, 14-16, 18, 24, and 26 pursuant to 35 U.S.C. §102(e) as anticipated by Halmann, et al. (US 6,526,163). Claim 2 was rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Zar (A Scan Conversion Engine . . .). Claims 4 and 17 were rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Hossack, et al. (US 6,352,511). Claims 6 and 19 were rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Okerlund, et al. (US 6,690,371). Claims 7 and 20 were rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Drebin, et al. (US 4,835,712). Claims 9 and 22 were rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Swerdloff (US 5,483,567). Claims 12, 13, and 25 were rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. Claim 27 was rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Edic, et al. (US 2004/0136490).

Claims 8, 10, 21, and 23 were objected to as being allowable if amended into independent form. Claims 10 and 23 have been amended into independent form. There are no intervening claims. Accordingly, claims 10 and 23 are allowable.

Applicants respectfully request reconsideration of the rejections of claims 1-7, 9, 11-20, 22, and 24-27, including independent claims 1 and 14.

Independent claim 1 recites a processor operable to identify acquired ultrasound data as a function of the values where a look-up table has the values corresponding to a spatial conversion from the display format to the acquisition format.

Halmann, et al. do not disclose this limitation. Halmann, et al. note that a CPU generates the scan converter tables necessary to convert scanned data from the polar coordinate system to the Cartesian coordinate system where the tables are dependent on the mode of operation (col. 7, lines 54-59). Scan conversion is performed with interpolation and the like (col. 8, line 53-col. 9, line 4). Halmann, et al. do not provide further details for the tables, but indicate that the tables convert the data. Halmann, et al. do not use values of the table to identify ultrasound data. There is no teaching that acquired ultrasound data is identified as a function of the values of the look-up table.

Claim 1 recites the table having values corresponding to a spatial conversion from the

display format to the acquisition format. Halmann, et al. convert polar coordinates into Cartesian coordinates (col 7, lines 55-57; and col 8, lines 64-65), not a look-up table used for the inverse conversion of Cartesian coordinates to the polar coordinates.

The Examiner alleges that, since the scan conversion is converting the polar scanned data to display values, it is identifying the polar data as a function of the Cartesian values, and alleges that the look-up table is reversible. However, Halmann, et al. do not disclose the structure of the lookup table. The lookup table, to be used for scan conversion, likely has interpolation values given an input Polar coordinate. The interpolation values are then applied to the data for that Polar coordinate to weight the data and create Cartesian data. The table is likely for interpolation values for the actual conversion of data at particular coordinates, so would not have a Cartesian coordinate output given a polar coordinate input.

Even if reversible, Halmann, et al. convert polar coordinate data to Cartesian coordinate data. There is no reason to identify polar coordinate data from or starting with a Cartesian coordinate. The process flows by providing polar coordinate data. The polar coordinate data is then interpolated (weighted and summed) to represent data at a Cartesian coordinate. The location of the Cartesian coordinate does not need to be known before hand. The available polar coordinate data is converted. An inverse lookup would not occur.

Independent claim 1 further recites that the processor is operable to avoid scan-conversion of volume data that does not contribute to a final volume rendered image, the identifying corresponding to identifying for display format coordinates associated with visible voxels of the final volume rendered image. Halmann, et al. simply scan converts all the incoming polar coordinate values for imaging. All the scan conversion tasks are completed so that a 2D image is generated (col. 9, lines 4-13). Volume rendering is performed from the 2D images (col. 5, lines 34-40). Halmann, et al. rely on polar coordinate to Cartesian coordinate scan conversion, converting all of the frames of data to provide 2D images, and then perform volume rendering from the 2D images. Halmann, et al. do not operate scan conversion as a function of the volume rendering, so do not avoid scan-conversion of volume data that does not contribute to a final volume rendered image, the identifying corresponding to identifying for display format coordinates associated with visible voxels of the final volume rendered image.

Independent claim 14 is allowable for similar reasons as claim 1.

Dependent claims 2-7, 9, 11-13, 15-20, 22, and 24-27 depend from claims 1 and 14, and are allowable for the same reasons as the corresponding base claim. Further limitations patentably distinguish from the cited references.

Claims 3 and 16 recite determining the display coordinates of interest and identifying the acquired ultrasound data by input of the display coordinates into the look-up table. The Examiner cites to col. 8, lines 4-9 of Halmann, et al. Halmann, et al. may locate an area of interest, but the area is not used to identify acquired data by input into the look-up table.

Claims 5 and 18 recite the display coordinates of interest input to the look-up table being coordinates for a plurality of rays through the volume. Halmann, et al. disclose a raycasting/volume rendering module 201, but this module 201 is not shown to work with the tables of the separate scan conversion module 207. The Examiner alleges there is no way to render an image if the original coordinates are polar, but that is not true. The rendering can account for any coordinate system.

Claim 11 recites a graphics processing unit (GPU). A GPU is a term of art for hardware designed specifically for graphics processing. The CPUs of Halmann, et al. are not GPUs merely because they process graphics. A person of ordinary skill in the art would understand that a CPU is not a GPU. Given the versatile processing taught by Halmann, et al. (see abstract), a person of ordinary skill in the art would use a CPU, not a GPU. The Examiner alleges that "GPU" must be broadly interpreted as a processor that processes graphics since the specification does not provide a more narrow meaning. However, those of skill in the art would understand GPU to have a more narrow meaning. As a term of art, GPU means more than just a processor that processes graphics. For example, NVIDIA defined, in 1999 , a GPU as "a single-chip processor with integrated transform, lighting, triangle setup/clipping and rendering engines that is capable of producing a minimum of 10 million polygons per second" (http://www.tweak3d.net/3ddictionary/3ddictionaryG.shtml). Data Center Now defines a GPU as: like the CPU (Central Processing Unit), it is a single-chip processor. However, the GPU is used primarily for computing 3D functions. This includes things such as lighting effects, object transformations, and 3D motion. Because these types of calculations are rather taxing on the CPU, the GPU can help the computer run

more effienciently. The first company to develop the GPU was NVidia, Inc. Its GeForce 256 GPU can process 10 million polygons per second and has over 22 million transistors. Compare that to the 9 million transistors found on the Pentium III chip. Wow -- that's a lot of processing power. There is also a workstation version of the chip called the Quadro, designed for CAD applications. This chip can process over 200 billion operations a second and deliver up to 17 million polygons per second. If only you could think that fast during those darn Calculus tests" (http://datacenternow.com/index.php?file=webpages/dictionary). Wikipedia notes: "a graphics processing unit or GPU (also occasionally called visual processing unit or VPU) is a dedicated graphics rendering device for a personal computer, workstation, or game console. Modern GPUs are very efficient at manipulating and displaying computer graphics, and their highly parallel structure makes them more effective than general-purpose CPUs for a range of complex algorithms. A GPU can sit on top of a video card, or it can be integrated directly into the motherboard. . . . A GPU implements a number of graphics primitive operations in a way that makes running them much faster than drawing directly to the screen with the host CPU. The most common operations for early 2D computer graphics include the BitBLT operation (combines several bitmap patterns using a RasterOp), usually in special hardware called a "blitter", and operations for drawing rectangles, triangles, circles, and arcs. Modern GPUs also have support for 3D computer graphics, and typically include digital video-related functions" (http://en.wikipedia.org/wiki/Graphics_processing_unit). Whether a single chip or multiple chips, a GPU is a known term of art for rendering images with 3D functions. People of ordinary skill in the art would recognize that the processor of Halmann, et al. is not a GPU. The Examiner cannot provide a broader meaning to a term of art, effectively creating his own definition contrary to accepted understanding.

Claim 15 recites outputting Polar coordinates interpolated from the look-up table. Halmann, et al. interpolate ultrasound data, but do not disclose outputting interpolated Polar coordinates from the table. The reference merely saying use interpolation would not lead a person of ordinary skill to output Polar coordinates interpolated from the look-up table. Halmann, et al. clearly intend to convert from polar to Cartesian.

Claim 26 recites generating a two-dimensional look-up table with acquisition format coordinates for each coordinate of a Cartesian volume. Halmann, et al. treat volume

rendering separately from scan conversion. There is no disclosure of a LUT for coordinates of a Cartesian volume. The Examiner alleges there is no way to render an image if the original coordinates are polar, but that is not true. The rendering can account for any coordinate system.

Claim 2 recites values of the look-up table being Polar coordinates where the look-up table is indexed by integer Cartesian coordinates. Halmann, et al. do not disclose coordinate values in the look-up table, and do not disclose Polar coordinates as the values of the look-up table indexed by Cartesian coordinates. Zar discloses bilinear interpolation of ultrasound data, not a look-up table of coordinates.

Claim 4 recites the processor operable to determine a plane through a volume as the display coordinates where the display coordinates are input to the look-up table. Hossack, et al. show arbitrary plane display for a volume, but do not use the coordinates of the plane as an input to the look-up table. Halmann, et al. treat volume rendering and scan conversion separately, so do not use coordinates of a plane in a volume as input to the scan conversion table. Claim 17 is allowable for similar reasons.

Claims 6 and 19 are allowable for the same reasons as claim 5. Claims 6 and 19 are also allowable because a person of ordinary skill in the art would not have used the cited rendering of Okerlund, et al. with Halmann, et al. The cited section for alpha blending of Okerlund, et al. teach a hardware based RGBA approach (col. 7, lines 4-19). Alpha blending is provided using hardware acceleration. However, Halmann, et al. desire versatility so use programmable CPUs to avoid hardware specialization (col. 2, lines 42-52). A person of ordinary skill in the art would not have used the hardware acceleration based alpha blending of Okerlund, et al. with the general programming approach of Halmann, et al. The Examiner alleges that the methods are compatible. However, CPU based rendering and hardware acceleration are alternatives.

Claim 12 recites a flag, and an integer sum. As noted in the specification, an integer sum allows indication of spatial relationship relative to other table entries. Halmann, et al. do not suggest any format for the look-up table, and certainly do not disclose an integer sum, a flag or fixed-point values. These values are chosen to allow table based identification of data rather than scan conversion of the data. Selective scan conversion of only the samples

that contribute to the rendering result without having to scan convert occluded data is provided by the recited table variables. A person of ordinary skill in the art would not have provided the listed classes as a mere design choice.

CONCLUSION

Applicants respectfully submit that all of the pending claims are in condition for allowance and seeks early allowance thereof. If for any reason, the Examiner is unable to allow the application but believes that an interview would be helpful to resolve any issues, he is respectfully requested to call Craig Summerfield at (312) 321-4726.

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